(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
23 January 2003 (23.01.2003)

PCT

(10) International Publication Number
WO 03/006165 A1

(51) International Patent Classification⁷: B02C 13/28, F21C 35/19, 35/18

(21) International Application Number: PCT/GB02/03224

(22) International Filing Date: 12 July 2002 (12.07.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0117024.0 12 July 2001 (12.07.2001) GB
0210172.3 3 May 2002 (03.05.2002) GB

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(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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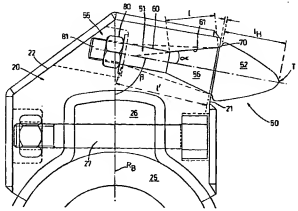
(54) Title: A TOOTH CAP ASSEMBLY



(57) Abstract: A mineral breaker tooth cap assembly comprising a tooth cap (20) detachably mounted in the cap, the cap being adapted to the detachably mounted on a radially projecting mounting boss (26) of a mineral breaker drum, the pick comprising an elongate body (51) having at one axial end a mineral breaking pick head (52) and at the opposite axial end tensile generating means (55), the elongate body further comprising a frusto-conical portion (56) which tapers inwardly from the pick head end of the body toward the tensile generating means of the body, said frusto-conical portion defining an abutment surface for abutment with a frusto-conical seat (61) located in said tooth cap, the frusto-conical portion having an angle of taper (α) which defines a shedding taper, said frusto-conical seat being of complementary shape and size to said frusto-conical portion of the elongate body, said frusto-conical seat and frusto-conical portion being in face to face contact and being held in abutment by said tensile generating means, the relative axial positions of said frusto-conical seat and frusto-conical portion being such as to axially space said pick head from the tooth cap so as to isolate said pick head from tensile loading applied by said tensile generating means.

WO 03/006165 A1

Published:

— *with international search report*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

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A TOOTH CAP ASSEMBLY

The present invention relates to a tooth cap assembly for use in a mineral processing machine.

In particular, but not exclusively, the invention relates to a tooth cap assembly having a mineral breaking pick for use in a mineral breaker having a pair of counter-rotating breaker drums of the type described in our European Patent No. 0 167 178.

Mineral breaking picks are commonly used in mineral processing machinery which are used for breaking mineral; this may be for the purpose of winning mineral from mineral deposits or for the purpose of breaking down lumps of mineral after mining.

It is recognised that picks need to be firmly anchored in a supporting body so that in use the pick is rigidly held in the supporting body without movement. However, it is also recognised that picks should be readily replaceable in order to enable new picks to be fitted once old picks have worn.

Heretofore these two requirements have tended to be mutually exclusive in that a pick which is easy to replace, in use, tends to work loose causing premature fracture of the pick, fall-out of the pick, and/or enlargement of the pick seat in the supporting body. Alternatively, a pick which is rigidly held in a supporting body without movement has tended to be difficult to remove after use.

A general aim of the present invention is to provide a tooth cap assembly including a mineral breaking pick in which the pick is capable of

being rigidly held in a supporting cap body without movement and yet, after use, is easy to replace.

According to one aspect of the present invention there is provided a mineral breaker tooth cap assembly comprising a tooth cap and a mineral breaking pick detachably mounted in the cap, the cap being adapted to be detachably mounted on a radially projecting mounting boss of a mineral breaker drum, the pick comprising an elongate body having at one axial end a mineral breaking pick head and at the opposite axial end tensile generating means, the elongate body further comprising a frusto-conical portion which tapers inwardly from the pick head end of the body toward the tensile generating means of the body, said frusto-conical portion defining an abutment surface for abutment with a frusto-conical seat located in said tooth cap, the frusto-conical portion having an angle of taper which defines a shedding taper, said frusto-conical seat being of complementary shape and size to said frusto-conical portion of the elongate body, said frusto-conical seat and frusto-conical portion being in face to face contact and being held in abutment by said tensile generating means, the relative axial positions of said frusto-conical seat and frusto-conical portion being such as to axially space said pick head from the tooth cap so as to isolate said pick head from tensile loadings applied by said tensile generating means.

According to another aspect of the present invention there is provided a mineral processing machine, preferably a mineral breaker, including a tooth cap assembly as defined above.

Various aspects of the present invention are hereinafter described with reference to the accompanying drawings, in which :-

Figure 1 is a side view, partly in section, of a mineral breaking pick mounted in a support in accordance with an embodiment of the present invention;

Figure 2 is an end view of a pair of breakers drums of a mineral breaker incorporating mineral breaker picks as shown in Figure 1;

Figure 3 is a plan view of a further embodiment of a tooth pick and support according to the present invention;

Figure 4 is a side view of the further embodiment shown in Figure 3;

Figure 5 is a front view of the further embodiment shown in Figure 3;

Figure 6 is an exploded perspective view of the support of the further embodiment and the mounting boss to which it is secured;

Figure 7 is an underside perspective view of the support of the further embodiment shown in Figure 3.

Referring initially to Figure 1 there is shown a mineral breaker tooth cap 20 of the type described in our UK Patent No. 2 176 424. Reference is made to UK Patent No. 2 170 424 for a detailed description of cap 20 and the manner by which it is mounted.

The tooth cap 20 defines a supporting body for a mineral breaking pick 50; the tooth cap 20 and pick 50 in combination define a mineral breaker tooth cap assembly according to the present invention.

The pick 50 comprises an elongate body 51 formed from a suitable metal such as a heat hardenable steel such as a grade EN24 steel.

Preferably the body 51 is initially formed by forging and then machined to accurate shape and dimensions.

The elongate body 51 has at one axial end a conical pick head 52 and at its opposite axial end a tensile generating means 55.

Intermediate the pick head 52 and tensile generating means 55, the elongate body 51 includes a frusto-conical portion 56 which tapers inwardly from the pick head toward the tensile generating means end of the elongate body 51.

The frusto-conical portion 56 has a taper angle α which is chosen to define a shedding angle.

In the present specification, 'shedding angle' means an angle of taper which does not impede axial separation of the frusto-conical portion from the supporting body; in other words a shedding angle is greater than an angle of taper which would provide an axial wedging or locking effect. Typically, a wedging taper angle is of the order of 1.5°.

In the present example, the taper angle is about 15° but it will be appreciated that the taper angle may be greater or less than 15°, provided that it defines a shedding taper.

As seen in Figure 1, the frusto-conical portion 56 has a maximum diameter end which is of substantially the same diameter as the maximum diameter of the conical pick head 52. Accordingly, there is a gradual transition in shape and size between the conical head 52 and the frusto-conical portion 56. This enables the head only to be heat treated to increase its surface hardness without creating a potential shear fracture region between the frusto-conical portion 56 and the head 52.

Accordingly, it is possible for the head 52 to be treated so as to have a hard exterior and yet have a relatively softer more resilient interior whilst the remainder of the elongate body retains its resilient character throughout. With this arrangement it is possible for the pick to tackle breakage of very hard yet resilient or tough minerals.

The pick body is received in a bore 60 formed in the cap 20; the bore 60 having a frusto-conical portion 61.

The frusto-conical bore portion 61 defines a seat against which the frusto-conical portion 56 is held in face to face abutment by the tensile generating means 55. In view of the abutment between the frusto-conical portion 56 and the seat defined by bore portion 61, the pick body is prevented from moving laterally relative to its axis and so is able to positively withstand side loadings applied by the pick head 52 during use. Thus, the pick body is rigidly held within the cap 20 without lateral movement as long as the tensile loading applied by the tensile generating means 55 maintains abutment between the frusto-conical portion 56 and the seat defined by bore portion 61.

As indicated in Figure 1, the length $\underline{l}$ of the frusto-conical portion 56 is relatively long and so provides a relatively large surface area for dissipating side loadings applied by the pick head 52. It will be appreciated that the length $\underline{l}$ may be varied by choosing a different taper angle (whilst maintaining substantially the same maximum diameter). Thus, for example, as shown by broken lines in Figure 1, the frusto-conical portion 56 may have a length $\underline{l}'$ which extends for substantially the entire length of bore 60.

Preferably therefore, the length $\underline{l}$ of the frusto-conical portion is chosen to be greater than about half the axial length l_H of the head 52.

In addition to preventing lateral displacement of the pick body, the frusto-conical portion 56 also acts to prevent axial movement of the pick body within the bore 60 in a direction towards its tensile generating means end. Thus, the tensile loading applied by the tensile generating means 55 is accommodated by abutment between the frusto-conical portion56 and the seat defined by bore portion 61. It will be appreciated therefore that adopting an angle of taper which defines a shedding taper is important as it enables a relatively high tensile load to be applied for preventing lateral displacement of the pick body without the risk of making it difficult to axially withdraw the pick body for replacement after release of the tensile generating means

As indicated in Figure 1, the pick head 52 may have a larger diameter than the maximum diameter of the frusto-conical portion 56 and thereby defines a shallow shoulder 70. In such a case, a gap G is formed between the shoulder 70 and the cap 20 in order to ensure that the tensile loadings applied by the tensile generating means 55 are accommodated by abutment between the frusto-conical portion 56 and the seat defined by bore portion 61 and not by the shoulder 70 engaging the cap 20.

Preferably as illustrated in Figure 1, the tensile generating means 55 comprise a screw threaded nut 80 which is threadably received on a screw threaded portion 81 of the elongate body 51

The amount of tensile loading applied on the elongate body 51 in between the tensile generating means 55 and the frusto-conical portion 56 is chosen to be in excess of a predetermined maximum loading which the pick head 52 is capable of applying to the elongate body by loads applied to the tip T of the head 52 during use. In this way, even if the head 52 applies its

predetermined maximum loading, the elongate body in between the tensile generating means 55 and the frusto-conical portion 56 remains under a tensile loading and so prevents release of the tensile generating means 55.

As seen in Figures 1 and 2, the cap 20 is mounted on annulus or ring 25 having a series of radially extending mounting bosses or noses 26. The bosses 26 each extend along a radial line R_B.

As seen in Figure 2, a pair of breaker drums 101, 102 are shown which contra-rotate relative to one another in the directions of arrow A. Each drum 101, 102 comprises a series of annuli 25 axially spaced along a shaft 103 such that the caps 20 are preferably arranged in helical formation as described in our European Patents Nos 0 096 706 and 0 167 178 to which reference should be made for a fuller description.

As seen in Figures 1 and 2, the bore 60 extends axially from a leading face 21 of cap 20 toward a trailing face 22. The terms 'leading' and 'trailing' are used with reference to the direction of rotation A.

Preferably as shown in Figures 1 and 2, the pick body is located almost entirely on the leading side of the radial line R_B and preferably the axis of bore 60 subtends an acute angle ß with radial line R_B. By adjusting this geometry the initial bite region B between a pair of opposed picks direct a majority of forces along the axis of each pick and thereby reduce side loadings in the initial bite region B.

A further embodiment 100 is illustrated in Figures 3 to 7. Parts similar to those in the embodiment shown in Figures 1 and 2 have been designated using the same reference numerals.

In the embodiment of Figures 3 to 7, the pick 50 is provided with anti-rotation means 150 which serve to prevent the pick 50 rotating within bore 60. This helps to ensure that during use the pick 50 does not rotate and possibly cause loosening of the tensile generating means 55.

Preferably the anti-rotation means 150 comprises one or more lugs 151 projecting from the leading face 21 of the support body and a corresponding number of recesses 152 formed in the pick head 52 which receive the lugs 151.

It will be appreciated that the anti-rotation means 150 may be provided in the embodiment of Figures 1 and 2.

The support body of embodiment 100 preferably comprises a cap 120 in the form of a cast body defining a pocket 200 in which an associated mounting boss 26 is seated.

As seen more clearly in Figure 7, the pocket 200 has a leading wall 201, a trailing wall 202, a pair of opposed side walls 203 and an upper wall 204.

Each side wall 203 is provided with a slot 208 in order to enable the leading and trailing walls 201, 202 respectively to be moved toward one another on tightening of bolt 27 which is responsible for securing the cap 120 to the mounting boss 26. In this way, tightening of the bolt 27 causes the leading and trailing walls 201, 202 to clamp against the opposed faces of the boss 26.

Preferably the side walls 203 are provided with apertures 210 communicating with the faces of leading and trailing walls 201, 202 respectively in order to enable feeler gauges to be inserted during the

assembly procedure and thereby enable an operative to check that the faces of the leading and trailing walls 201, 202 respectively are clamped against the opposed faces of the boss 26.

Preferably each slot 208 is 'T' shaped. Preferably the head part of the 'T' slot extends for the entire space between the leading and trailing walls 201, 202 and is preferably located so as to border the upper wall 204. This enables the leading and trailing walls 201, 202 to be flexed toward one another with minimum effort on tightening of bolt 27.

Preferably the cap 120 is provided with protection wear plates 125 mounted on its outer leading face 21, outer top face 23 and outer trailing faces 22 respectively.

Preferably each wear plate 125 is secured in place by welding. Preferably the cast body of cap 120 has chamfered edges 128 which underlie the respective wear plate 125 and thereby enable a line of welding to be made which underlies the wear plate 125 and so is protected thereby during use. As shown each wear plate 125 is planar and so is of sheet-like form and so can be conveniently produced.

It is to be understood that caps 20,120 are examples of a support body for picks 50 according to the present invention and that support bodies from other types of mineral processing machines may be adapted to receive picks 50.

CLAIMS

1. A mineral breaker tooth cap assembly comprising a tooth cap and a mineral breaking pick detachably mounted in the cap, the cap being adapted to be detachably mounted on a radially projecting mounting boss of a mineral breaker drum, the pick comprising an elongate body having at one axial end a mineral breaking pick head and at the opposite axial end tensile generating means, the elongate body further comprising a frusto-conical portion which tapers inwardly from the pick head end of the body toward the tensile generating means of the body, said frusto-conical portion defining an abutment surface for abutment with a frusto-conical seat located in said tooth cap, the frusto-conical portion having an angle of taper which defines a shedding taper, said frusto-conical seat being of complementary shape and size to said frusto-conical portion of the elongate body, said frusto-conical seat and frusto-conical portion being in face to face contact and being held in abutment by said tensile generating means, the relative axial positions of said frusto-conical seat and frusto-conical portion being such as to axially space said pick head from the tooth cap so as to isolate said pick head from tensile loadings applied by said tensile generating means.

2. A tooth cap assembly according to Claim 1 wherein said pick head is integrally formed on the axial end of said frusto-conical portion.

3. A tooth cap assembly according to Claim 2 wherein said elongate body is made of a metal which is heat treatable to increase its surface hardness, the pick head only being heat treated to increase its surface hardness relative to the frusto-conical portion.

4. A tooth cap assembly according to Claim 3 wherein said metal is steel.

5. A tooth cap assembly according to any of Claims 1 to 4 wherein said pick head is generally conical in shape and wherein the axial length of said frusto-conical portion is greater than half the axial length of the pick head.

6. A tooth cap assembly according to Claim 5, wherein the axial length of the frusto-conical portion is greater than the axial length of the pick head.

7. A tooth cap assembly according to Claim 5 or 6, wherein the maximum diameter of the frusto-conical portion is greater than half the maximum diameter of the pick head.

8. A tooth cap assembly according to Claim 7, wherein the maximum diameter of the frusto-conical portion and that of the pick head are substantially the same.

9. A tooth cap assembly according to any preceding claim wherein said tensile generating means comprises a screw threaded nut received on a screw threaded end portion of said elongate body.

10. A tooth cap assembly according to any preceding claim wherein said pick includes anti-rotation means to prevent the pick rotating within the tooth cap.

11. A tooth cap assembly according to any preceding claim wherein said tooth cap is cast from a suitable metal to include a pocket defined by a leading wall, a trailing wall and a top wall, said pocket being shaped and dimensioned to be seated upon said mounting boss of the mineral breaker drum.

12. A tooth cap assembly according to Claim 11 wherein said pick is mounted in said cap so as to project beyond said leading face and be positioned such that said elongate body is located substantially entirely on the leading side of the radial line along which the boss extends.

13. A tooth cap assembly according to Claim 11 or 12 wherein the longitudinal axis of the elongate body subtends an acute angle with the radial line along which the boss extends.

14. A tooth cap assembly according to any of Claims 11 to 13 wherein the outer surface of the leading, trailing and top walls of the cap are covered by planar wear plates which are fixedly secured thereto.

15. A tooth cap assembly according to any of Claims 11 to 14 wherein the tooth cap includes a pair of opposed side walls which define opposite sides of said pocket, the side walls including radially extending slots which enable the leading and trailing walls to be moved toward one another for clamping engagement with opposed faces of the mounting boss.

16. A tooth cap assembly according to Claim 15 wherein each side wall has a 'T'shaped slot, the head portion of the 'T' shaped slot extending between the leading and trailing walls.

17. A mineral breaker including a plurality of tooth cap assemblies according to any preceding claim.

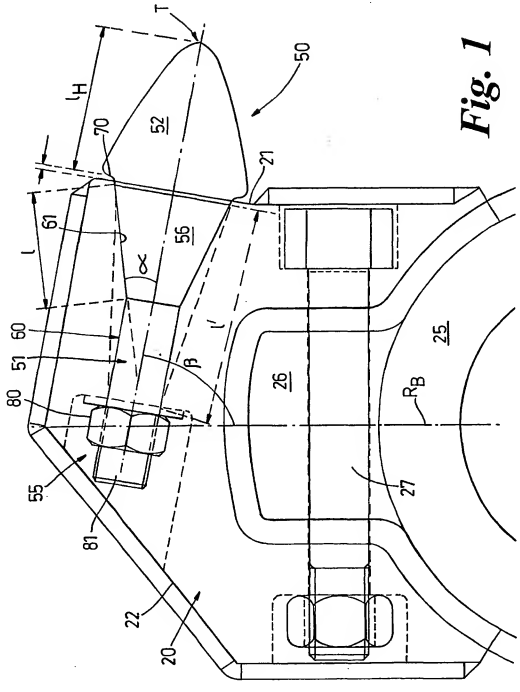

Fig. 1

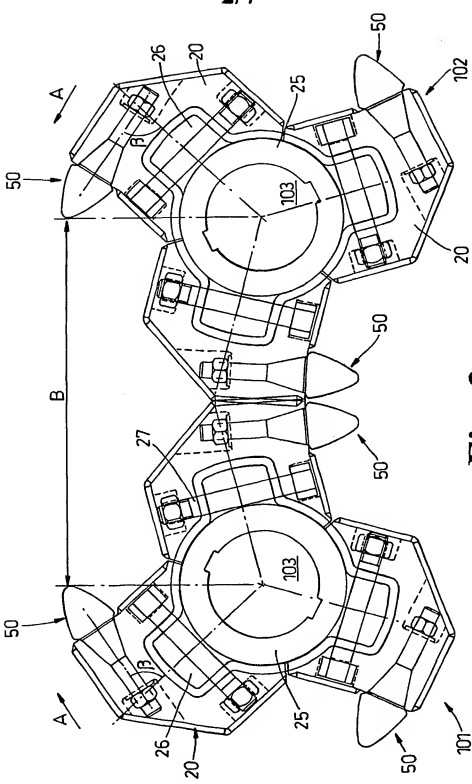

Fig. 2

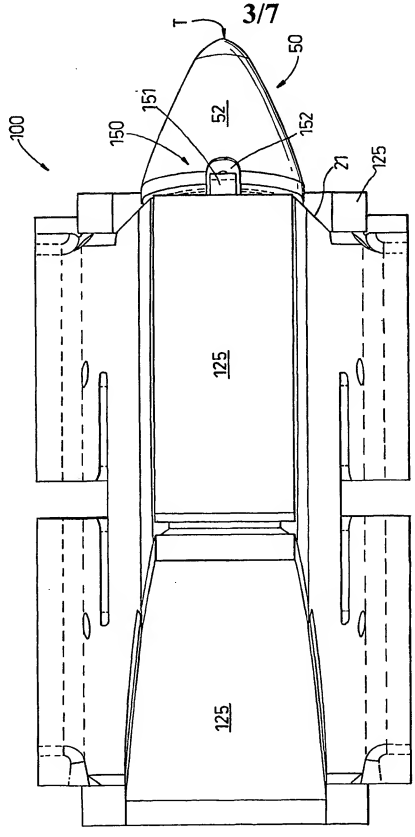

Fig. 3

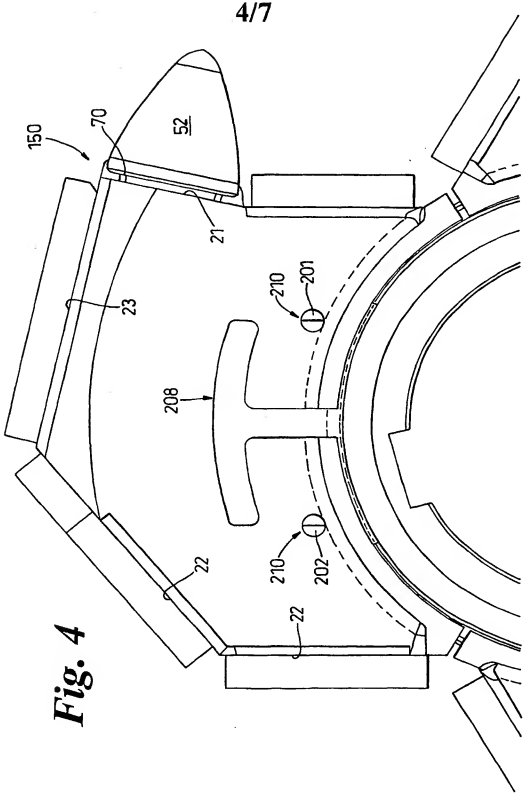

Fig. 4

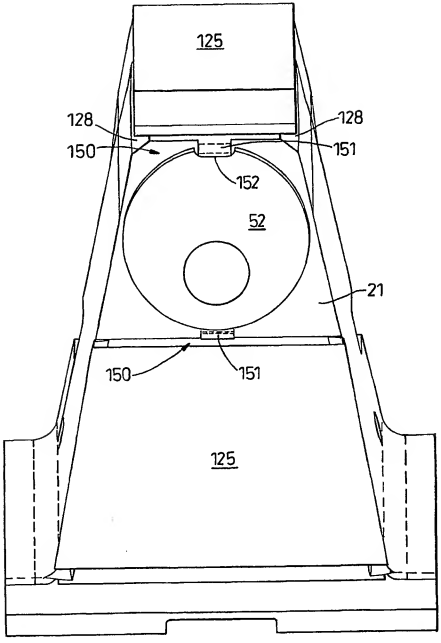

Fig. 5

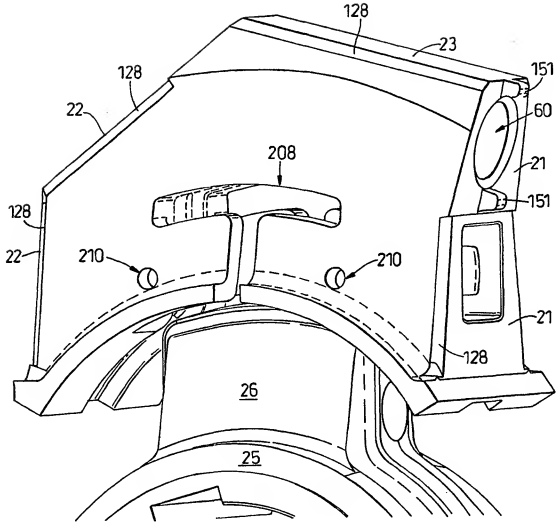

Fig. 6

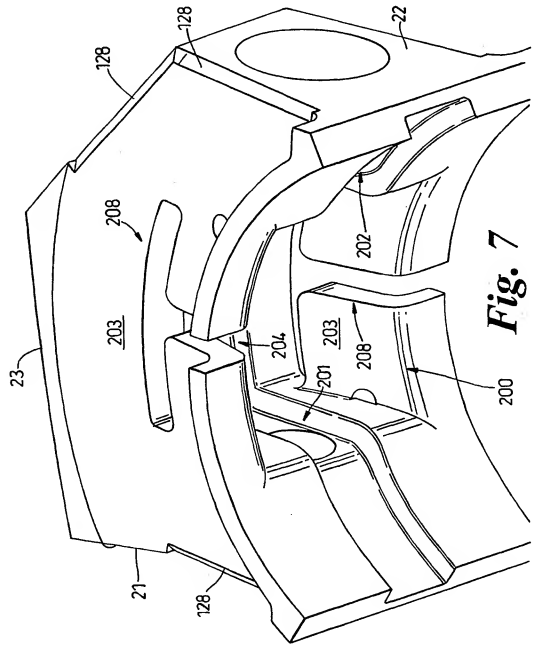

Fig. 7

INTERNATIONAL SEARCH REPORT

Int Jonal Application No
PCT/GB 02/03224

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B02C13/28 E21C35/19 E21C35/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B02C E21C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	column 3, line 23 - line 37; figures 8,9	
A	EP 0 114 725 A (MMD DESIGN & CONSULT) 1 August 1984 (1984-08-01) page 6, line 16 -page 7, line 1; figures 8,9	1,13

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

'A' document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
22 October 2002	11/11/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Kopacz, I

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 02/03224

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